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The impact of Artificial Intelligence technologies on international supply chains in international business

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Abstract. *Artificial intelligence (AI) technologies have emerged as a dominant force that is revolutionizing international supply chains within the broader context of international business. This paper represents a comprehensive examination of the ways in which AI reshapes global supply chain operations, with a particular focus on its*

impact on the competitive dynamics faced by multinational companies, operational efficiency, supply chain resilience, and risk management. The analysis, which incorporates data from MarketsandMarkets, Grand View Research, Gartner, and McKinsey reports, as well as empirical studies from ResearchGate and leading academic journals, demonstrates the explosive growth of the AI-driven supply chain solutions market. The market is projected to reach a value of over USD 50-236 billion by 2030-2035, with compound annual growth rates ranging from 20% to 42.7%. The most significant applications of machine learning are demand forecasting that has been improved by 10–65% in terms of accuracy, predictive maintenance, route optimization, inventory management, and real-time risk monitoring. The tangible benefits of international operations are demonstrated by practical case studies of leading companies, including Amazon, Walmart, Maersk, DHL and UPS. The study emphasizes the role of AI in promoting sustainable practices, supporting supplier diversification amid geopolitical tensions, and enhancing visibility across multi-tier global value chains. Nevertheless, obstacles continue to exist, such as regulatory divergences (e.g., EU AI Act), cybersecurity risks in cross-border data flows, skills deficits, and ethical concerns. In general, the research affirms that AI is fundamentally altering the architecture of international supply chains, necessitating adaptive strategies while providing multinational corporations with competitive advantages. The paper could be beneficial to international organizations as well as policymakers, entrepreneurs, and researchers. Additional research is advised regarding the integration of generative AI, the ethical frameworks for global deployment, and the influence of regulation on the adoption of AI in emerging markets.

Key words: *artificial intelligence, international supply chains, global value chains, supply chain resilience, international business, demand forecasting, predictive analytics, digital transformation.*

АКТУАЛЬНІ ПИТАННЯ ЕКОНОМІЧНИХ НАУК

Вплив технологій штучного інтелекту на міжнародні ланцюги постачань у міжнародному бізнесі

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Анотація. *Технології штучного інтелекту (ШІ) стали основним фактором, що революціонізує міжнародні ланцюги постачання в світовому контексті міжнародного бізнесу. Дана стаття містить комплексний аналіз процесу переформатування глобальних операцій ланцюгів постачання, з окремим акцентом впливу ШІ на конкурентну динаміку, з якою стикаються транснаціональні компанії, операційну ефективність, стійкість ланцюгів постачання та управління ризиками. Аналіз, що включає дані з звітів MarketsandMarkets, Grand View Research, Gartner та McKinsey, а також емпіричні дослідження з ResearchGate та провідних наукових журналів, демонструє стрімке зростання ринку ШІ-рішень для ланцюгів постачання. За*

прогнозами, до 2030-2035 рр. обсяг ринку перевищить 50-236 млрд доларів США, а середньорічний темп зростання становитиме від 20% до 42,7%. Найбільш значущими сферами застосування машинного навчання є прогнозування попиту, точність якого покращилася на 10-65%, попереднє технічне обслуговування, оптимізація маршрутів, управління запасами та моніторинг ризиків у реальному часі. Конкретні переваги міжнародної діяльності демонструють практичні кейси провідних компаній, зокрема Amazon, Walmart, Maersk, DHL та UPS. У дослідженні підкреслюється роль ШІ у просуванні сталого розвитку, підтримці диверсифікації постачальників в умовах геополітичної напруженості та підвищенні прозорості в багаторівневих глобальних ланцюгах створення вартості. Проте, все ще існують перешкоди, такі як розбіжності в законодавстві (зокрема, Акт про штучний інтелект), ризики у сфері кібербезпеки при міжнародному обміні інформацією, дефіцит кваліфікованих кадрів та етичні проблеми. Загалом дослідження підтверджує, що ШІ фундаментально змінює архітектуру міжнародних ланцюгів постачання, потребуючи адаптивних стратегій, водночас надаючи транснаціональним корпораціям конкурентні переваги. Ця стаття може бути корисною для міжнародних організацій, а також для політиків, підприємців та дослідників. Подальші дослідження передбачаються в сфері інтеграції генеративного ШІ, розробки етичних засад для глобального впровадження та вивчення впливу регулювання на впровадження ШІ на ринках країн, що розвиваються.

***Ключові слова**: штучний інтелект, міжнародні ланцюги постачань, глобальні ланцюги створення вартості, стійкість ланцюгів постачань, міжнародний бізнес, прогнозування попиту, прогнозна аналітика, цифрова трансформація.*

Problem statement. The contemporary landscape of international business is characterized by unprecedented complexity in global supply chains, exacerbated by geopolitical tensions, climate-related disruptions, pandemics, and rapid shifts in consumer demand. Artificial intelligence technologies have emerged as a transformative force capable of addressing these challenges through enhanced predictive capabilities, automation, and real-time decision-making. In an era where multinational enterprises manage multi-tier supplier networks spanning continents, AI offers unprecedented visibility and agility that traditional systems cannot match. The relevance of this study stems from the accelerating adoption of AI across supply chain functions and its profound implications for competitive positioning in international markets. Traditional supply chain models, reliant on manual processes and static forecasting, have proven vulnerable to black swan events, as evidenced by the COVID-19 pandemic and ongoing conflicts that disrupted global flows of goods. AI-driven solutions, encompassing machine learning, deep learning, natural language processing, computer vision, and generative AI, enable dynamic responses that mitigate risks and optimize operations on a global scale.

This paper seeks to fill a notable gap in the literature by providing a holistic examination of AI's impact specifically within the context of international business, rather than limiting analysis to domestic or sectoral applications. While prior studies have explored isolated AI applications or general supply chain efficiency, few have integrated empirical cases from leading multinationals with macroeconomic data on market growth and regulatory considerations across borders. The central research questions address how AI enhances operational efficiency and resilience in international supply chains, the practical mechanisms through which companies achieve competitive advantages, the challenges posed by cross-border implementation, and the prospects for sustainable and ethical deployment.

Analysis of recent research and publications. The integration of artificial intelligence into supply chain management has attracted substantial scholarly attention, with systematic literature reviews and empirical studies underscoring its transformative potential while highlighting implementation barriers. Toorajipour et al. (2021) conducted one of the earliest comprehensive systematic literature reviews on AI in supply chain management [1], identifying prevalent techniques such as artificial neural networks, fuzzy logic, and agent-based systems as dominant contributors to forecasting, inventory optimization, and logistics. Their analysis revealed that AI primarily enhances efficiency but noted a scarcity of studies addressing ethical and cross-border regulatory dimensions critical to international business.

Building on this foundation, Culot et al. (2024) performed an updated systematic literature review of empirical studies on AI in supply chain management [2], categorizing research themes into data and system requirements, technology deployment processes, inter-organizational integration, and performance implications. The authors emphasized that while AI delivers measurable gains in visibility and decision speed, success hinges on organizational readiness rather than technology alone, particularly in multinational settings where data sovereignty and interoperability vary across jurisdictions.

Recent works have shifted focus toward resilience and sustainability. Teixeira et al. (2025) and Samuels (2025) examined AI's role in building resilient supply chains post-pandemic [3; 4], demonstrating through quantitative models that machine learning and predictive analytics improve risk assessment accuracy by 20–50% and reduce stockouts significantly. Wu et al. (2025) specifically addressed international dimensions [5], arguing that AI development promotes supply chain diversification by lowering coordination costs and enabling real-time supplier scouting, thereby mitigating geopolitical risks in global value chains.

Empirical case-oriented research further enriches the discourse. Singh (2025), in a thesis analyzing international supply chain management through the Technology-Organization-Environment framework [6], used the Scurite Software Company as a case to illustrate how AI integrates partner data for enhanced forecasting and risk management, while cautioning against data quality issues in cross-border contexts. Kanaan et al. (2025) quantified benefits in visibility and decision-making [7], reporting 20–30% inventory cost reductions and 65% forecasting accuracy improvements across studied companies.

Additional studies explore sustainability and emerging technologies. He et al. (2025) linked AI to manufacturing resilience via innovation and digital empowerment [8], while Pagare et al. (2025) reviewed the synergistic effects of AI with blockchain, digital twins, and IoT in fostering agile and resilient supply chains [9].

The adoption and resilience of AI in global contexts have been further elucidated by recent systematic literature reviews and empirical studies. The TOE framework was employed by Shahzadi et al. (2024) to conduct a systematic literature review of AI adoption in supply chain management [10]. The review identified specific technological, organizational, and environmental reasons and obstacles that are particularly pertinent for multinational corporations that operate across borders. Vlachos and Reddy (2025) conducted an analysis of 107 machine learning studies published between 2019 and 2023 [11], emphasizing the expanding role of ML in predictive analytics and optimization within intricate global supply chains. Smyth et al. (2024) proposed a strategic framework for decision-makers in volatile international environments [12], with a particular emphasis on prescriptive analytics made possible by AI as a key component of supply chain resilience. Organizational Information Processing Theory was implemented by Pan et al. (2025) to illustrate how the utilization of AI improves supply chain resilience by enhancing information processing capabilities in the presence of uncertainty [13]. In 2025, Ferreira et al. conducted an

updated systematic review of AI applications in supply chain management and delineated future research directions [14]. Cannas et al. (2024) presented numerous case studies of real-world AI implementation in supply chain and operations management [15], illustrating practical mechanisms and organizational challenges in multinational settings. Logozar et al. (2024) conducted a systematic literature review on the multifaceted role of artificial intelligence in supply chain management, emphasizing its contributions to resilience and optimization in international contexts [16]. Collectively, these works verify the beneficial impact of AI on fundamental supply chain functions. However, they consistently identify deficiencies in comprehensive analyses of international business implications, regulatory harmonization, and long-term ethical considerations. This paper endeavors to address these deficiencies by utilizing integrated market data and multinational case studies.

Statement of the article's objectives. The primary purpose of this research paper is to provide a thorough examination of the impact of artificial intelligence technologies on the efficacy, resilience, risk management, and competitive dynamics of international supply chains. By integrating academic literature, market statistics, and comprehensive corporate case studies, the study endeavors to offer actionable insights for scholars, practitioners, and policymakers who are navigating the digital evolution of global trade.

Main results of research. The global market for AI applications in supply chain management exhibits remarkable dynamism, reflecting the technology’s rapid penetration into international business operations. According to MarketsandMarkets and Grand View Research analyses [17; 18], the sector was valued at approximately USD 9-14 billion in 2024-2025 and is projected to reach between USD 50 billion and USD 236 billion by 2030-2035, with compound annual growth rates spanning 20% to 42.7% depending on the source and scope including software, hardware, and services. This expansion is driven by escalating supply chain complexity, e-commerce growth,

and the imperative for resilience amid geopolitical volatility. Gartner reports indicate that overall supply chain management software revenue reached USD 33.4 billion in 2024, growing 12.4% year-over-year, with AI components constituting an increasingly dominant share [19]. McKinsey's global surveys further reveal that organizations deploying AI in supply chain and inventory functions report the highest revenue uplifts, underscoring tangible returns on investment [20].

In terms of specific applications, AI technologies are reshaping every stage of the supply chain operations reference (SCOR) model - plan, source, make, deliver, and return. Machine learning algorithms excel in demand forecasting by processing vast datasets encompassing historical sales, weather patterns, social media sentiment, and economic indicators, achieving accuracy improvements of 10–65% compared to traditional methods. Currency fluctuations, tariffs, and regional demand fluctuations complicate planning, rendering this capability particularly advantageous in international business. Predictive analytics and computer vision optimize inventory management, enabling real-time stock level adjustments that reduce holding costs by 20-35% and stockouts by 30-50%. Route optimization powered by reinforcement learning and natural language processing minimizes transportation expenses and emissions, critical for multinational logistics networks spanning continents.

Risk management and resilience represent another cornerstone of AI's contribution. Platforms employing natural language processing scan global news, weather data, and geopolitical developments to predict disruptions, allowing proactive rerouting or sourcing diversification. These capabilities have been indispensible in the context of international supply chains, allowing businesses to comply with evolving regulations and maintain continuity during events such as the Suez Canal blockage or trade sanctions. The benefits of sustainability are equally substantial. AI-driven optimization reduces fuel consumption and carbon footprints, thereby supporting corporate ESG objectives in global markets with varying environmental standards.

Practical implementation is vividly illustrated through leading multinational corporations. Amazon exemplifies AI's transformative power in global fulfillment [21]. Through its acquisition and scaling of Kiva Systems (now Amazon Robotics), the company has deployed over 520,000-1 million mobile robots across fulfillment centers worldwide. These AI-enabled robots, combined with deep learning for inventory placement and demand forecasting, have reduced processing times by 20-25%, cut operational costs per warehouse by up to 30%, and achieved near-perfect picking accuracy. AI directly contributes to Amazon's dominance in e-commerce supply chains that span dozens of countries by optimizing last-mile delivery, predicting regional demand increases such as holiday surges in Europe or Asia, and coordinating cross-border shipments in international operations.

Walmart, another retail giant with extensive international presence, leverages AI for end-to-end visibility and optimization. Its systems process petabytes of data hourly from point-of-sale terminals, weather feeds, and supplier inputs to forecast demand with unprecedented precision. Implementation of AI routing and inventory algorithms has reportedly generated over USD 1.5 billion in savings while reducing stockouts by 16-20% across its 11,000+ stores globally. Walmart's AI also assists in navigating tariff changes and supplier diversification strategies, ensuring continuity of fresh produce and consumer goods supply from multiple continents.

The impact of AI on maritime logistics is illustrated by Maersk, the world's largest container transportation company. Maersk's predictive maintenance AI has reduced unplanned downtime by 30% across its fleet of over 700 vessels by analyzing over 2 billion data points daily from vessel sensors, weather, and terminal operations. Optimized routing and fuel efficiency have resulted in a reduction of 1.5 million tons of CO2 emissions, in addition to annual savings exceeding USD 300 million. Digital twins for scenario planning and supplier discovery tools are additional AI applications

that directly support global trade flows by enhancing resilience against port congestions or geopolitical blockades.

Through its Resilience360 platform, DHL, a global leader in international express and logistics, has integrated AI to monitor more than 140 risk categories using machine learning and natural language processing on global data streams. The system enables proactive modifications to shipments during disruptions by providing real-time alerts and mitigation recommendations. Throughout DHL's global network, dynamic routing algorithms have resulted in fuel efficiency and delivery speed enhancements of 15–25% respectively. These capabilities have been indispensable for clients who are responsible for the management of intricate international supply chains, ranging from pharmaceuticals to automotive parts, by reducing compliance risks and delays.

These examples are complemented by UPS's ORION (On-Road Integration Optimization and Navigation) system, an AI-powered routing tool that analyzes trillions of route combinations throughout the day [22]. Since its deployment, ORION has reduced driven miles by over 100 million and saved hundreds of millions of dollars annually in fuel, resulting in commensurate environmental benefits. In addition, the system optimizes transcontinental routes by incorporating customs data and border conditions.

Comparative analysis of these cases reveals common success factors: robust data infrastructure, organizational integration of AI insights into decision-making, and strategic partnerships for cross-border data sharing. Quantifiable outcomes consistently include cost reductions of 15-35%, efficiency gains, and enhanced resilience, directly translating into competitive advantages in international markets. However, challenges remain pronounced. Data quality and integration across legacy systems and international partners often hinder full potential realization. Regulatory landscapes vary sharply. Europe’s AI Act imposes stringent transparency requirements, while data localization laws in certain Asian markets complicate global platforms. Cybersecurity

vulnerabilities in interconnected supply chains pose systemic risks, and skills shortages limit adoption in smaller or developing-country segments of global networks. Ethical considerations, including algorithmic bias in supplier selection or job displacement from automation, demand proactive governance.

The accompanying table provides an analytical overview of the primary developmental directions and challenges, based on synthesized research and case evidence.

Table 1

The main directions of AI development in international supply chains within the context of international business

Directions	Comments
Technological innovations as the primary objective	Machine learning and generative AI for forecasting and scenario planning; digital twins and IoT integration for real-time visibility across borders; blockchain-AI hybrids for traceability.
Focus on resilience and risk management	Predictive analytics for geopolitical and climate risks; dynamic rerouting and supplier diversification tools; enhanced visibility reducing disruption impacts
Sustainability and efficiency gains	Route and load optimization cutting emissions; predictive maintenance lowering resource use; circular economy support through AI-driven recycling and reuse forecasting.
Competitive advantages for multinational enterprises	Cost reductions; faster response to global demand shifts; improved compliance with international trade regulations via NLP for tariff and sanctions screening.
Target audiences and implementation contexts	Large multinationals in retail, logistics, manufacturing, and automotive; emerging applications in SMEs via cloud-based AI services; regional variations with faster adoption in North America and Asia-Pacific.
Challenges and regulatory considerations	Data privacy and sovereignty across jurisdictions; cybersecurity in global networks; skills gaps and high initial investment; ethical governance and EU AI Act compliance.

Source: own analysis based on market reports and case studies.

Conclusions. The profound transformations in the landscape of international business are revealed by the comprehensive examination of the influence of artificial intelligence technologies on international supply chains. Market analyses verify the explosive growth of AI solutions [17-20], which are expected to expand significantly and provide significant improvements in sustainability, resilience, and efficiency. Detailed case studies of Amazon, Walmart, Maersk, DHL, and UPS, as well as systematic literature reviews [1-16], provide empirical evidence that AI applications in forecasting, inventory optimization, logistics, maintenance, and risk management result in measurable competitive advantages. These advantages include cost savings of 15–35%, accuracy improvements exceeding 50%, and an improved capacity to navigate global disruptions.

AI enhances visibility across intricate global value chains, encourages strategic diversification in the face of geopolitical uncertainties, and stimulates sustainable practices that are consistent with changing consumer and regulatory expectations in the international context. However, the complete potential of the organization is contingent upon the resolution of integration obstacles, regulatory fragmentation, cybersecurity threats, and human capital challenges. In conclusion, the research confirms that AI is not merely an operational instrument, but a strategic imperative that is currently reshaping the competitive dynamics and international supply chain architecture.

Prospects for additional research include the development of ethical governance frameworks for AI-driven global commerce, the examination of cross-cultural and regulatory impacts on the adoption of AI in emerging markets, and a more thorough examination of generative and agentic AI uses.

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